

ME-400: Exam 2 (Fall 2012)

(The exam is open book, time 75 min. **SHOW ALL YOUR WORK**)

Name: _____

1. Experiments conducted during the machining of AISI-4140 steel with fixed values of depth of cut and feed yield the following results:

Cutting Speed V (m/min)	Tool Life T (min)
160	7.0
180	5.5
200	5.0

- Find the interpolating polynomial $p_2(V) \approx T(V)$ of degree 2 to the given data (15 points).
- Find the piecewise linear interpolant to the given data (10 points)
- Find an error bound or estimate for the approximation in b) (15 points)
(Hint: use the problem data to estimate the derivatives of $T(V)$)

2. Consider the integral $I = \int_0^1 \frac{dx}{2-x} \doteq 0.693147$, and the three points $x_0 = 0$, $x_1 = 1/2$ and $x_2 = 1$.

- Find an approximation to I using the composite trapezoidal rule in the two subintervals (10 points)
- Find the minimum size of $h = x_i - x_{i-1}$ necessary to achieve an accuracy of 5×10^{-6} using the composite trapezoidal rule (10 points).
- Find an approximation to I using Simpson's rule (10 points).
- Find an approximation to I using the composite one-point Gauss quadrature (15 points).
- Find another approximation to I using the one-point Gauss quadrature in $[0, 1]$ and use the results of d) and e) in the Richardson extrapolation formula to improve the approximation (15 points).